

TARGETING ORCHIDS AND OTHER EPIPHYTES IN A CONSERVATION EDUCATION PROGRAM IN COSTA RICA

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ABSTRACT. Education is one of the most effective approaches to promote conservation. Costa Rica has a rich orchid flora, but it also has one of the highest rates of deforestation in the world. Maintaining Costa Rica's high biodiversity, including 1,200 reported species of orchids, has been the mission of many local and international research and conservation organizations including Selby Gardens. As a pilot program, training activities for local elementary school teachers started at the Jardín Botánico Lankester in Costa Rica, in December 1993, and were implemented until September 1994. The program was an effective technique to promote and enhance teaching strategies for conservation education. Results from this pilot program supported the need for outreach in local school communities, involving students and faculty in the conservation role of botanical gardens.

WHY ORCHID CONSERVATION?

Tropical rain forests, which occupy only 6% of the earth's land system, contain approximately half of the species of organisms on earth. Conservation of these plant reservoirs is urgently needed, especially in some areas of Latin America where most biological diversity remains intact. The establishment of national and international networks of on-site (in situ) integration or off-site (ex situ) conservation activities is one of the global strategies for conserving biodiversity. This comprehensive approach will help maximize diversity by fostering linkages with training, research and education programs in developing countries.

According to Wilson (1992), the diversity of an ecosystem, including rain forests, is measured by its capacity to retain and conserve nutrients. In a tropical environment the plant diversity can be indicated by the number of orchids and other epiphytes. Epiphytes are not just the greatest multipliers of the rain forests, but are also indicators of their biological diversity.

Orchids are the most diverse plant family in the world. They represent about 40% of the total monocot plants, and comprise approximately 17% of the 90,000 plants in Latin America (Forero 1991). Gentry and Dodson (1987) estimated that in Andean regions of Ecuador, Colombia and Peru most of the endemic orchid habitats are rare and local. According to Wilson (1992), orchids are susceptible to changes in their habitats because of their extreme vulnerability and high rate of infant mortality. Consequently, a large colony of orchids in a harsh environment can die, and disappear before leaving any record of survival.

Costa Rica has one of the highest rates of deforestation in the world. Most of this situation

was caused by economic pressures (i.e., mainly conversion of rain forest into cattle ranches). Costa Rica had 72% of its land covered by forests in 1950. Ellenberg (1987) reported that only 20% of that forested area was still undisturbed in 1987.

This tiny country, with its rich biological diversity, has been the center for a conservation structure where federal and international organizations are actively working to maintain Costa Rica as "El Jardín de las Americas" (The Garden of the Americas). Among many research and conservation programs currently in progress in the country are two major flora projects: *Flora Mesoamericana* and *Flora Costaricensis* (Campbell & Hammond 1989). As a branch of the latter project, an orchid inventory was initiated in 1984 as *Orchids of La Selva*, now known as *Flora Costaricensis-Orchidaceae* (John Atwood pers. comm.). *Flora Costaricensis-Orchidaceae* is continuing today with a plan of publishing results in the near future.

This important endeavor in orchid research and conservation receives professional and technical assistance from the Field Museum of Natural History and the Orchid Identification Center of The Marie Selby Botanical Gardens in the United States, as well as domestic institutions in Costa Rica. In 1987, Botanic Gardens Conservation International, an international organization helping to strengthen global network for plant conservation, developed an action plan known as Botanic Gardens Conservation Strategy, to be implemented worldwide. As an example of networks among research and conservation organizations solicited by this strategy, Selby Gardens has linked its conservation education activities with a Costa Rican organization, Jardín Botánico Lankester. These organizations are now a partnership in orchid conservation

through their cooperative missions and activities.

EFFORTS IN ORCHID CONSERVATION

Orchids, known as the Royal Family of plants, are well recognized for their beauty and incredible diversity (Stewart 1991). There are approximately 25,000 species known, and every year more than 100 new species are described. Although some species may exhibit leafy stems of up to 10m long, a high number of orchids meet the miniature status in the vegetative and blooming parts.

Species diversity relates to a wide range of habitats and ecological requirements. Orchids range from terrestrial types to air plants or epiphytes, where they have been the most successful. More than 14,000 orchid species are dependent on woody vegetation. Due to their vulnerable habitat, in many instances their endurance is extremely short.

Maintaining orchids in botanical gardens has been a long-term mission of many conservation organizations. Although orchids occur for relatively long periods in nature, many wild-collected orchids live only a few years under their cultivated conditions. However, in some botanical gardens, such as Kew Gardens in England and Jardín Botánico Lankester in Costa Rica, many exotic orchid collections have lived up to 100 years (Stewart 1991). Although these reports are important for orchid research and conservation, lack of trained staff and the high cost of suitable environmentally controlled buildings hinder these conservation efforts, particularly in tropical and developing regions.

EX-SITU CONSERVATION IN BOTANICAL GARDENS

Although off-site conservation is one of the less effective means of conserving genetic diversity (Ledec & Goodland 1988), it does play an important role in orchid protection if it is combined with education. Off-site conservation includes facilities where species population size, adaptation mechanisms and other important biological features can be studied. The goal, of course, is the long-term protection of orchid diversity and habitat. Botanical gardens are important centers for plant conservation. Indeed, botanical gardens of the world currently have under cultivation more than 35,000 plant species accounting for 15% of the world's flora (Raven 1981).

At the international level, the Botanic Gardens Conservation International (BGCI), based in Surrey, United Kingdom, enforces conserva-

tion efforts among members of this global network (BGCI 1987). In many botanical gardens, collections are enhanced through plant-collecting expeditions and other research activities. According to BGCI, the incorporation of living and dried plants into the botanical gardens' collections is one of the best methods for monitoring plant distribution and habitats at the regional, national and international levels.

Among other immediate actions, the global network for plant conservation summarized in the World Conservation Strategy, a conceptual basis from the International Union for Conservation of Nature (IUCN) linking conservation with development, stating: "we need more education and training" (Davis *et al.* 1986). According to many plant conservation experts, none of the imperative needs and actions to maintain the integrity of plant species will occur unless there is a continuous educational program in every plant research center, especially those located in the tropics. These important programs should incorporate periodic training sessions, particularly those that address the severe shortage of trained scientists and technicians with conservation skills in Latin America (Forero 1991).

IMPORTANT OUTCOMES IN ORCHID CONSERVATION

Contributions in several tropical countries have provided enormous support for orchid conservation. Some of these endeavors have demonstrated the importance of ex situ conservation programs in botanical gardens. The united efforts of Bogor, Cibodas, Purwodadi and Bali Botanical Gardens have provided information on the current orchid taxonomic status in tropical areas such as Java and other Malaysian regions (Riswan *et al.* 1991).

Other contributions have focused on the conservation of habitats of wild orchid species. Lamb (1991) reviewed the habitat requirements for wild orchids (particularly for epiphytic species) and discussed the horticultural value of these requirements for botanical gardens. Sites surveyed in his investigation included Kew Gardens and its Orchid Herbarium, Sydney Botanic Gardens, Singapore Botanic Garden, Selby Botanical Gardens and many other famous orchid conservation centers.

While some botanical gardens have attempted to identify their role in orchid research and the best approaches to accomplish this important mission (Rasmussen & Rasmussen 1991), others are still trying to improve propagation techniques in vitro for specific projects on endangered orchid species in the wild, or simply as an

effective technique to maintain and enhance tropical live orchid collections (Mitchell 1991).

Despite different attempts of botanical gardens to clarify whether orchid conservation is a necessity or a luxury (Stewart 1991), none of these organizations has considered linking their important efforts in orchid conservation to their education programs. It is imperative to explore more effective links between orchid conservation and relevant educational programs and community involvement.

ORCHID FLORA AND ECOTOURISM IN COSTA RICA

Costa Rica has one of the richest orchid floras in Central America, followed by Panama and Mexico (Dressler 1981). Since almost 20% of the plants occurring in Latin America are orchids, they should receive priority in the conservation education activities of botanical gardens located in this tropical region (Forero 1991). The Jardín Botánico Lankester, Cartago, Costa Rica, is an orchid center whose mission is to promote the conservation of epiphytic plants of the country, with special emphasis in orchids. Of the 1,200 species reported in Costa Rica, the gardens maintain more than 800 orchid species with almost half of them being native. Because of this imposing number of plants and the quality of its collections, Jardín Botánico Lankester is not just an internationally acclaimed orchid conservation center, but a renowned attraction for worldwide tourism.

Costa Rica is an important center for ecotourism where in 1990 the business provided the country's second most important outside source of revenues (Wilson 1992). According to the director of Jardín Botánico Lankester, Dora Emilia Mora de Retana, a high percentage of the Garden's 35,000 annual visitors are ecotourists from the United States and many European countries (pers. comm.). Much of the tourism industry in Costa Rica is due to its many national parks; consequently, most visitors (about 60%) are ecotourists (Boo 1990, Boza 1993).

Ecotourism has an emphasis on conservation education programs in Costa Rica. National pride in Costa Rican natural heritage has been an important element in the consolidation of the country's ecotourism business. Because of the importance of this enterprise and the pressing need to convince visitors of the significance of conservation, a series of educational initiatives have been implemented in the last 15 years. These attempts have had different aims ranging from assessing the simple impact of tourism on natural areas, to involving residents and tourists

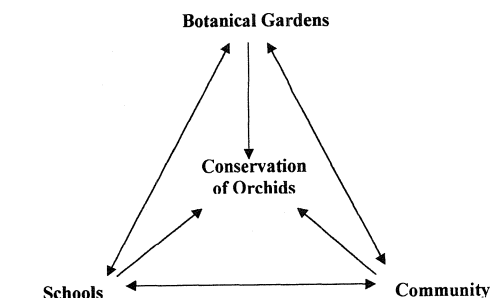


FIGURE 1. Educational model utilized to promote orchid conservation in Jardín Botánico Lankester, Costa Rica.

in the preservation of the country's natural resources. (Jacobson and Robles 1992).

INSTRUCTIONAL APPROACH IN ORCHID CONSERVATION. According to Forero (1991), mutual cooperation between botanical gardens of developed countries and those located in tropical regions needs intensification. Through resolutions contained in Botanic Gardens Conservation Strategy (IUCN-BGCS, WWF 1989), the International Association of Botanic Gardens and the BGCI have encouraged their institutions to join efforts and work with sister gardens in their mission of plant conservation. This strategy also recommended that botanical gardens provide service to local communities, become important centers in public education, and support a framework for training with an emphasis on conservation.

In their mission statements, The Marie Selby Botanical Gardens and Jardín Botánico Lankester stated their goals to work intensively in orchid research and conservation. Both botanical institutions identified education as one of the most effective approaches to promote conservation. This is supported by international accords contained in the Environmental Education Strategy for Botanic Gardens established in 1993. This educational action plan for plant conservation encourages botanical gardens to raise awareness in local schools by showing teachers and their students how to use botanical gardens as permanent teaching resources.

The ultimate goal of this instructional approach for orchid conservation is to advise Costa Ricans of the distinctive biological diversity of their orchid flora. It also helps instill in them a sense of pride in the conservation program. This conservation education program includes in its model (FIGURE 1) three important components, each with individual aims but under one integrated mission: conservation of orchids and their habitats. The integral elements included in the

educational model are environmental awareness in botanical gardens, community involvement, and alliance with local schools.

This important alternative approach to sustain ex situ orchid conservation in Jardín Botánico Lankester will (a) cultivate a positive impact in the country by creating and promoting awareness in communities and ecotourists; (b) reinforce environmental ethics by developing a national pride among the citizens of those communities; and (c) support orchid conservation efforts in Costa Rica by offering continuous training activities for local school teachers, tourist guides and community leaders.

TRAINING ACTIVITIES IN LOCAL SCHOOLS. Training developing-country nationals is a critical ingredient to conserve biodiversity (Wemmer *et al.* 1993). This imperative action for global and local conservation is incomplete without the support of local school teachers. Educators are an active foundation in every community. Teachers can generate public awareness on issues of conservation through different instructional techniques in and out of their classroom settings (Calhoun 1990). Botanic Gardens Conservation Strategy recommended instructing educators to play public relation roles in botanical gardens and help these institutions in ex situ conservation missions. Many conservationists claim that developing conservation education programs, and using the programs' efforts to modify school curricula, are a necessity in Latin America, particularly in Costa Rica (Boza 1993, Forero 1991).

Training activities for local elementary school teachers started at Jardín Botánico Lankester in December 1993. As a pilot program, this first activity was intended to examine teaching materials and attitudinal evaluation forms specially designed for the training program. Fifteen elementary teachers representing three neighboring communities participated in this test activity. The program included five major categories selected as awareness indicators for the attitudinal evaluation forms.

These indicators were extensively covered during the training session, and the teachers' attitudinal outcomes are summarized in FIGURE 2. Results obtained in this pilot program supported the necessity of botanical gardens in Latin America to work with local schools and promote the conservation role of botanical gardens. The scores shown in other attitudinal indicators also favored the training program. The program was an effective method of promoting and enhancing teaching strategies and other techniques recommended for conservation education. Finally, the attitudinal scores and overall evaluation forms

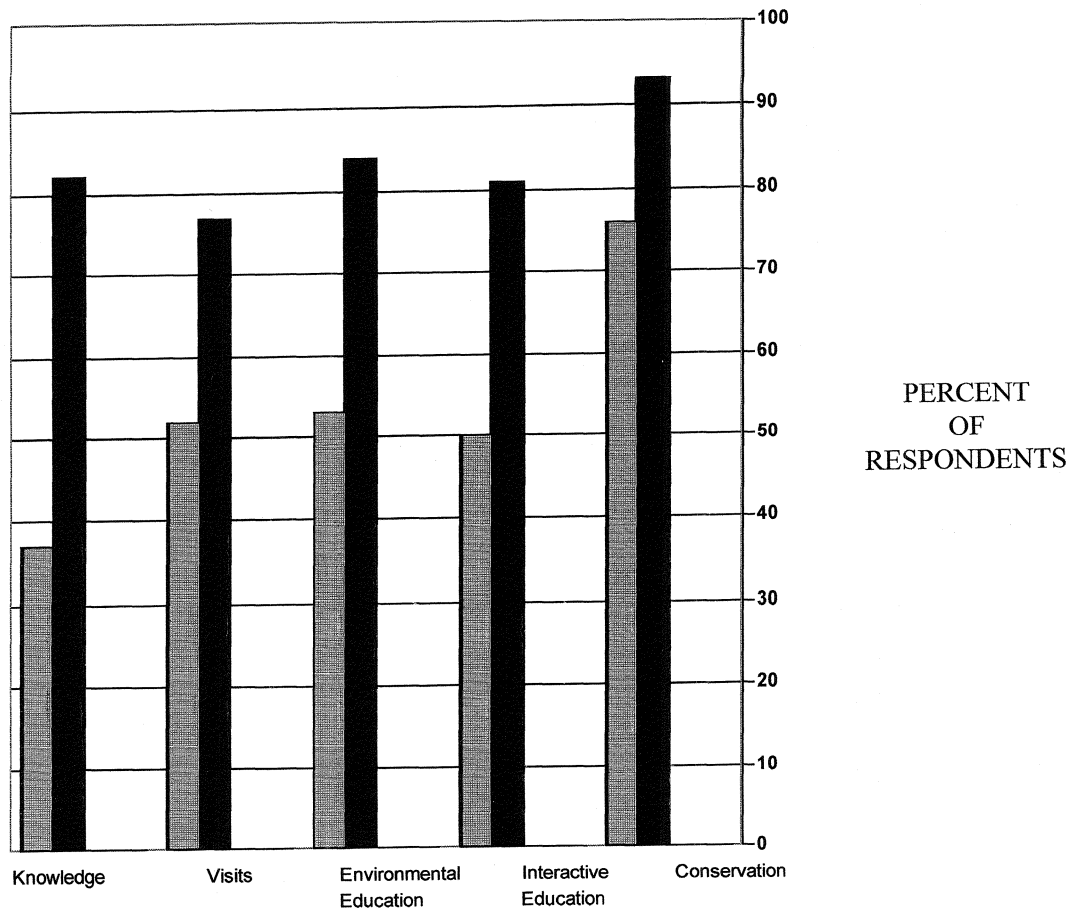
suggested extending the training program, including continuous follow-up sessions, and keeping educators updated with the gardens' role in orchid conservation.

COMMUNITY-INVOLVEMENT ACTIVITIES. Tropical and subtropical botanical gardens are advised to concentrate efforts on the inventory and conservation of local floras. Periodic implementation of those endeavors will determine threatened, endangered or rare plants in the inventory. According to Hernandez-Bermejo (1987), communities should be made aware of the need to conserve their local plant heritage. Community-involvement programs invite local residents to be active in conservation programs and to feel that they are the beneficiaries of their country's resources. The experiences of Jardín Botánico "Francisco Javier Clavijero" of Xalapa, Veracruz, Mexico and of Jardín Botánico "Lancetilla" in Tela, Honduras, have shown favorable support of community actions for plant conservation (IUCN/WWF 1989).

As an indispensable action group in the educational model, it is assumed that orchid conservation should begin with those claiming the natural heritage: the Costa Ricans. The use of training schemes, practical participation of local schoolteachers, and the incorporation of an active community-involvement element, will help domestic and international visitors recognize the gardens' mission in orchid conservation. Succession of actions for this component of the conservation education program is illustrated in FIGURE 3.

PUBLIC EDUCATION AND AWARENESS FOR ORCHID CONSERVATION. Education is a major component in the conservation activities of every botanical garden. With visitors numbering more than 150 million a year, worldwide, and the incipient ecotourism business in many Latin American countries (Heywood 1991), every botanical garden should have an education and conservation awareness plan. They should identify audiences, establish unambiguous missions, and target instructional media to transmit their conservation message. The challenge for many conservation educators has been to find the most effective strategy for learning in botanical gardens. Unfortunately, there is no single pattern to promote and develop conservation awareness, but there are several factors that will make it have more impact.

One element in any conservation education message is the interactive approach, which means an active audience. Informal learning settings in botanical gardens need to motivate participants. Natural learning experiences in conservation need to make visitors an active part of



CONSERVATION AWARENESS INDICATORS



 = Pre training
 = Post training

FIGURE 2. Relative frequency of percentage scores of two equivalent multiple-choice test forms given to school teachers before and after completing their training. Conservation awareness indicators were (K) knowledge about orchid conservation, (V) number of visits to Jardín Botánico Lankester, (EE) current training in environmental education, (IE) use of interactive teaching.

their environment. Orchids are an appealing group of plants. Using interpretive exhibits to spread the conservation message, as shown in FIGURE 4, and keeping the visitors' curiosity and interest will be the essential ingredients in the design and completion of these educational materials. This type of learning should develop and enhance in visitors their view on orchid conservation and prolong this attitude beyond the gardens' gate. National parks throughout Latin America have used similar efforts in conserva-

tion education and have found the general public responding positively to their natural heritage (Boza 1993, Rivero 1989).

CHALLENGE FOR ORCHID CONSERVATION IN COSTA RICA

In the tropics, botanical gardens should be guardians of plant diversity. To accomplish this crucial task, these plant conservation centers should maintain permanent affiliation with local

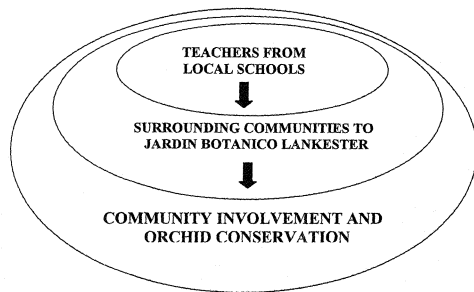


FIGURE 3. Instructional scheme practiced with school teachers in Jardín Botánico Lankester to promote involvement in orchid conservation (centrifugal mode).

communities, their leaders, and their schools. Through this alliance, the community maintains its support of gardens' outreach programs and the educators impart effective conservation messages in active learning situations. Consequently, conservation of orchids in Costa Rica will not be left solely to Jardín Botánico Lankester. According to a Senegalese conservationist, "In the end, we will preserve only what we love, we will love what we understand, we will understand only what we are taught" (Rodes & Odell 1992). Costa Rica should focus its educational programs on orchid conservation. It might help Costa Ricans to continue their efforts in habitat conservation, using orchids as "flagship" plants.

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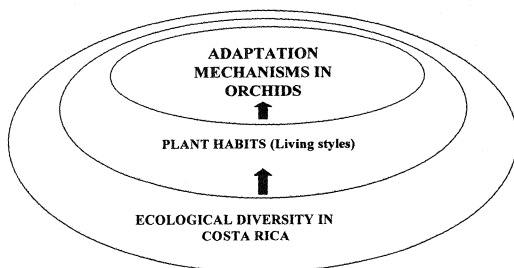


FIGURE 4. Sequence of content followed to develop instructional resources for orchid conservation in Jardín Botánico Lankester (centripetal mode).

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